ENGINEERING CHANGE NOTICE

1. ECN 635527

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Cheryl J. Benar, Data Assessment and Interpretation, R2-12, 372-1256	[] Yes [X] No	08/06/97
	6. Project Title/No./Work Order No. Tank 241-B-111	7. Bldg./Sys./Fac. No. 241-B-111	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-549, Rev. 1	10. Related ECN No(s). ECN-635438	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change   13b. Design Baseline Document? [] Yes [X] No

This ECN was generated to include additional explanatory text in the best-basis narrative, and to update the comprehensive radionuclide inventory estimates for the tank.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Initial release of this document was deficient.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. C.J. Benar	C.J. Benar	8/20/97	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	8/20/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-B-111

Cheryl J. Benar
Lockheed Martin Hanford, Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: ECN-635527 UC: 2070
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Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-B-111, 241-B-111, B-111, B Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-B-111. This report supports the requirements of the Tri-Party Agreement Milestone M-44-05.

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RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-549	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-B-111

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 06/06/96 on EDT-616006.	C.J. Benar	J.G. Kristofzski
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1-A RS	Incorporate per ECN-635527.	C.J. Benar	K.M. Hall
		C.J. Benar 8/20/97	Kathleen M Hall 8/20/97

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3.0 BEST-BASIS INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing the wastes into a form that is suitable for long-term storage.

Chemical inventory information generally is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1997). Not surprisingly, information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization information for the various waste management activities (Hodgson and LeClair 1996). Appendix D contains the complete narrative regarding the derivation of the inventory estimates presented in Tables 3-1 and 3-2.

Table 3-1. Sample-Based Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-111 (September 30, 1996).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment RSD %
Al	958	S	7
Bi	21,500	S	1
Ca	734	S	23
Cl	1,090	S	2
TIC as CO_3	23,600	S	11
Cr	1,180	S	5
F	1,660	S	2
Fe	18,800	S	5
Hg	9.93	S	50
K	718	S	18
La	12	S	27
Mn	83.9	S	6

Table 3-1. Sample-Based Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-111 (September 30, 1996).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment RSD %
Na	102,000	S	2
Ni	22.1	S	7
NO_2	47,800	S	9
NO_3	87,200	S	8
OH[2]	0	C	Accounted for by CO_3
Pb	1,670	S	7
P as PO_4	51,800	S	8
Si	11,100	S	8
S as SO_4	12,400	S	1
Sr	232	S	2
TOC	932	S	12
U_{TOTAL}	210	S	4
Zr	15.3	S	29

Note:

[1]S = Sample-based, M = Hanford Defined Waste model-based, E = Engineering assessment-based
[2]C = Calculated by charge balance; includes oxides as hydroxides, not including Co_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-111 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,or E)[1]	Comment RSD%
^{3}H	13.2	M	
^{14}C	1.7	S	36
^{59}Ni	11.6	M	
^{60}Co	< 4.12	S	
^{63}Ni	1170	M	
^{79}Se	11	M	
^{90}Sr	264000	S	22
^{90}Y	264000	S	Based on ^{90}Sr

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-111 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,or E)[1]	Comment RSD%
^{93m}Nb	37.9	M	
^{93}Zr	50.5	M	
^{99}Tc	121	S	10
^{106}Ru	0.0376	M	
^{113m}Cd	216	M	
^{125}Sb	15.2	M	
^{126}Sn	17.1	M	
^{129}I	0.0341	M	
^{134}Cs	0.774	M	
^{137m}Ba	159000	S	Based on ^{137}Cs
^{137}Cs	168000	S	9
^{151}Sm	41000	M	
^{152}Eu	12.5	M	
^{154}Eu	181	S	26
^{155}Eu	932	M	
^{226}Ra	7.29 E-04	M	
^{227}Ac	0.00393	M	
^{228}Ra	0.00252	M	
^{229}Th	5.91 E-05	M	
^{231}Pa	0.00885	M	
^{232}Th	3.11 E-04	M	
^{232}U	0.0054	M	
^{233}U	0.0207	M	
^{234}U	0.14	M	
^{235}U	0.00613	M	
^{236}U	0.00164	M	
^{237}Np	0.0761	S	22
^{238}Pu	9.79	M	
^{238}U	0.143	M	
$^{239/240}Pu$	104	S	5
^{241}Am	90.1	S	25
^{241}Pu	683	M	
^{242}Cm	0.345	M	

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-111 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,or E)[1]	Comment RSD%
^{242}Pu	0.00392	M	
^{243}Am	0.0116	M	
$^{243/244}Cm$	0.816	M	57

[1]S=Sample-based
M=Hanford Defined Waste model-based
E=Engineering assessment-based

APPENDIX D

BEST-BASIS FOR SINGLE-SHELL TANK 241-B-111

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APPENDIX D

BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-111

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for waste management activities (Hodgson and LeClair). As part of this effort, an evaluation of available chemical information for tank 241-B-111 was performed, and a best-basis inventory was established. This work follows the methodology established by the standard inventory task.

D1.0 IDENTIFY/COMPILE INVENTORY SOURCES

The TCR for tank 241-B-111 (Giamberardini 1993) provides characterization results from the 1991 sampling event for this tank. Two core samples were obtained and analyzed. A sample-based inventory was prepared based on the core sample analytical results using a waste density of 1.19 g/mL, and a waste volume of 897 kL (237 kgal). This waste volume is the total waste volume which includes 893 kL (236 kgal) of sludge and 4 kL (1kgal) of supernatant. The HDW model (Agnew et al. 1996a) provides tank contents estimates, derived from process flowsheets and waste volume records.

D2.0 COMPARE COMPONENT INVENTORY VALUES AND NOTE SIGNIFICANT DIFFERENCES

Tables D2-1 and D2-2 show the sample-based inventory estimate from the TCR and the inventory estimate from the HDW model (Agnew et al. 1996a) for tank 241-B-111. (The chemical species are reported without charge designation per the best-basis inventory convention). The waste solids volume used to generate both inventories is 893 kL (236 kgal). The estimates, however, use different waste densities. The sample-based inventory used a bulk density of 1.19 g/mL, which is the overall tank density calculated from the sample data (Giamberardini 1993). The HDW model uses a lower waste density, 1.16 g/mL, which is an estimate derived from process flowsheets and waste volume records. Several significant differences between the sample-based and HDW model inventories are apparent, for example, Al, Bi, Ca, Cl, Cr, Fe, Hg, K, Mn, Na, NH_4, Ni, NO_2, NO_3, Pb, PO_4, Si, S, U, and Zr vary by a factor of two or more.

Table D2-1. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-111. (2 sheets)

Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)	Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)
Al	958	166	Ni	22.1	496
Ag	6.34	---	NO_2	47,800	3,110
As	29.7	---	NO_3	87,200	32,700
B	54.8	---	OH	---	50,900
Ba	30	---	oxalate	---	0.0012
Be	<1.85	---	Pb	1,670	1.27
Bi	21,500	6,790	Pd	55.9	---
Ca	734	9,860	P as PO_4	51,800	10,600
Ce	34.2	---	Pt	---	---
Cd	2.95	---	Re	---	---
Cl	1,090	546	Rh	<37.2	---
Co	4.72	---	Ru	<18.5	---
Cr	1,180	408	Sb	19.5	---
Cr^{+3}	---	408	Se	34.4	---
Cr^{+6}	171	---	Si	11,100	1,710
Cs	---	---	S as SO_4	12,400	3,400
Cu	214	---	Sn	<297	---
F	1,660	1,650	Sr	232	0.00046
Fe	18,800	51,800	Te	38.4	--
FeCN/CN	2.0	0	TIC as CO_3	23,600	14,800
Formate	---	---	Th	<2.75E+06	---
Hg	9.93	0.0077	Ti	8.42	--
K	718	133	TOC	932	--
La	12	0.0022	total U	210	4,120
Li	<7.43	---	V	4.19	---

Table D2-1. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-111. (2 sheets)

Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)	Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)
Mg	208	---	W	<29.7	---
Mn	83.9	0.88	Zn	118	---
Mo	44.4	---	Zr	15.3	0.086
Na	102,000	31,800	H_2O(Wt%)	63.1	78.2
Nd	23.5	---	Density (kg/L)	1.19	1.16
NH_4	48.8	430			

Table D2-2. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Radioactive Components in Tank 241-B-111.

Analyte	Sampling inventory estimate (Ci)	HDW model inventory estimate (Ci)	Analyte	Sampling inventory estimate (Ci)	HDW model inventory estimate (Ci)
^{14}C	1.7	n/r	^{237}Np	0.0761	n/r
^{90}Sr	264,000	1,350,000	$^{239/240}Pu$	104	157
^{99}Tc	121	n/r	^{241}Am	90.1	n/r
^{129}I	n/r	n/r	Total α	188	n/r
^{137}Cs	168,000	56,100	Total β	669,000	n/r
^{154}Eu	181	n/r			

Note:

n/r = not reported

D3.0 REVIEW AND EVALUATION OF COMPONENT INVENTORIES

The following evaluation of tank contents is performed to identify potential errors and/or missing information that could influence the sample-based and HDW model component inventories.

D3.1 CONTRIBUTING WASTE TYPES

Tank 241-B-111 was put into service in December 1945 as the second tank in a three-tank cascade that also included tanks 241-B-110 and 241-B-112 cascade. The cascade received 2C waste from B Plant. Waste began overflowing to tank 241-B-112 in April 1946.
Tank 241-B-112 was filled in August 1946, and the 2C waste was diverted to a cascade that included tanks 241-B-104, 241-B-105, and 241-B-106 cascade.

After the 241-B-104, 241-B-105 and 241-B-106 cascade was filled, the supernatant from the 241-B-110 cascade was pumped to cribs. The 241-B-110 cascade again received 2C waste from B Plant in July 1950 and continued to do so until B Plant was shut down in June 1952. Tank 241-B-112 began overflowing to a crib in second quarter of 1951 (Anderson 1990).

After B Plant was shut down in June 1952, the 241-B-110 cascade began receiving a concentrated flush waste from B Plant. This concentrate showed up in tank 241-B-111 in the third quarter of 1952. In 1963, tank 241-B-111 began receiving fission product waste from B Plant via tank 241-B-110.

Table D3-1 shows the current waste volumes for the tanks in the 241-B-110 cascade(Hanlon 1996).

Table D3-1. Waste Inventory of 241-B-110, 241-B-111, and 241-B-112 Cascade.

Inventory	Tank 241-B-110 (kL)	Tank 241-B-111 (kL)	Tank 241-B-112 (kL)
Sludge	927	893	114
Saltcake	0	0	0
Supernatant	4	4	11
Drainable interstitial liquid	83	79	0

Table D3-2 lists the documented quantities of waste discharged to tank 241-B-111 from the HDW model waste transaction database.

Table D3-2. Waste Transaction Information for Tank 241-B-111.

	Waste Type	Waste Volume (kL)
Waste throughput	2C2	n/r
	DW	818
	P2 (PUREX high-level waste 1964-1967)	2,532
	CSR (Waste sent to B Plant for cesium recovery)	7,093
Total waste throughput		10,443
Current solids inventory[2]		893

Note:
[1]Agnew et al. (1996)
[2]Hanlon (1996)

Table D3-3 shows the types of solids accumulated in tank 241-B-111 that were reported by various authors. All sources indicate that second cycle bismuth phosphate waste should be the principal contribution to the waste solids in the tank.

Table D3-3. Expected Solids for Tank 241-B-111.

Reference	Type
Anderson (1990)	2C, 5-6, EB, FP, FP-EB, EB-IX, IX
SORWT model (Hill et al. 1995)	2C, 5-6, FP, IX
WSTRS (Agnew et al. 1996b)	2C2, DW, P2, BY saltcake
HDW model (Agnew et al. 1996a)	2C2, DW, P2, CSR

Notes:
SORWT = sort on radioactive waste type

D3.2 EVALUATION OF PROCESS FLOWSHEET INFORMATION

An estimate of the bismuth phosphate waste discharged to the 241-B-110 cascade can be made from the tank farm process history and the reconstructed fuel processing history in Appendix B of Kupfer (1996). Table D3-4 summarizes this estimate.

Table D3-4. B Plant Fuel Processing and 2C Waste Disposition.

Cascade	Period	Fuel Processed (MTU)
241-B-110/241-B-111/241-B-112	April 1945 to August 1946	631
241-B-104/241-B-105/241-B-106	September 1946 to June 1950	1,312
241-B-110/241-B-111/241-B-112	July 1950 to June 1952	823

An estimate of the amount of 2C waste discharged to each cascade can be made from the fuel process history and the flowsheet information in Appendix C of Kupfer (1996). The technical manual flowsheet is applied to the first time period and the Schneider (1951) flowsheet was applied to the last two time periods. The technical manual, issued in 1944, is considered representative of early B Plant operations, whereas the Schneider (1951) flowsheet is considered more representative of later years. Table D3-5 shows the results of this calculation.

Table D3-5. Disposition of B Plant 2C Waste.

Period[1]	5/45-8/46	9/46-6/50	7/50-8/52	Total
Cascade	241-B-110	241-B-104	241-B-110	B Plant
Fuel processed (MTU)	631	1,312	823	2,766
Waste component (kg)				
Bi	9,050	23,600	14,800	49,800
Cr	417	1,180	741	2,490
F	19,900	53,800	33,700	113,000
Fe	8,580	31,500	19,800	66,000
Na	283,000	674,000	423,000	1,500,000
NO_3	364,000	1,130,000	708,000	2,380,000
Si	4,900	13,100	8,200	27,700
PO_4	235,000	422,000	265,000	891,000
SO_4	29,500	106,000	66,700	224,000

Note:

Dates are provided in the mm/yy format.

Table D3-6 compares the calculated discharge of the 241-B-110 cascade to the sample-based inventory for tanks 241-B-110 and 241-B-111 is shown. Table D3-6 shows nearly equal accumulations of sludge in tanks 241-B-110 and 241-B-111. The waste transaction records state that both inventories are 2C waste. Overall a lack of agreement exists between the sample-based estimate for the tanks 241-B-110 and 241-B-111 versus the B Plant 2C waste projected to be discharged to the 241-B-110 cascade.

Table D3-7 compares the sample-based inventory, the HDW model inventory, and the flowsheet projected inventory. The best agreement for the species most likely to precipitate (Bi, Cr, Fe, and Si) is between the flowsheet based estimate and the sample-based estimate.

The sample-based data for tank 241-B-110 appears to account for the 2C waste discharged to the 241-B-110 cascade. This is the expected result for the first tank in a cascade. This result, however, is at odds with the large inventory of bismuth-bearing sludge found in tank 241-B-111.

Overall reconciliation of the 241-B-110, 241-B-111, and 241-B-112 cascade receipts to the sum of tank 241-B-110 and tank 241-B-111 is poor although the sludge in tanks 241-B-110 and 241-B-111 exhibit the characteristics of 2C waste. The waste is unlikely to be 1C waste because the Zr, Al, and Ce content is too low. The flowsheet evaluation projection accounts for approximately half of the 2C waste found in tanks 241-B-110 and 241-B-111 based on sample analysis. A possible explanation is that the throughput rate was twice the documented rate.

Table D3-6. Comparison of Tank 241-B-110 and Tank 241-B-111 Inventory Estimates to Total Cascade Receipts.

Waste Component (kg)	Tank 241-B-110 Sample-Based Inventory Estimate (kg)	Tank 241-B-111 Sample-Based Inventory Estimate (kg)	Total Calculated Inventory Discharged to B-110, B-111, B-112 Cascade (kg)	HDW B-110, B-111, B-112 Cascade Retained (kg)
Bi	23,200	21,500	23,900	21,000
Cr	1,014	1,180	1,160	792
F	2,370	1,660	53,600	4,400
Fe	22,600	18,800	28,400	89,600
Na	122,000	102,000	706,000	116,000
NO_3	234,000	87,200	1,070,000	108,000
Si	11,700	11,100	13,100	4,210
PO_4	31,600	51,800	500,000	69,000
SO_4	14,400	12,400	96,200	7,930

Table D3-7. Comparison of Tank 241-B-111 Inventory Estimates to 241-B-110 Cascade Receipts.

Waste Component (kg)	Sample-Based Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)	Calculated Inventory Discharged to Cascade (kg)
Bi	21,500	6,790	23,900
Cr	1,180	408	1,160
F	1,660	1,650	53,600
Fe	18,800	51,800	28,400
Na	102,000	31,800	706,000
NO_3	87,200	32,700	1,070,000
Si	11,100	1,700	13,100
PO_4	51,800	10,600	500,000
SO_4	12,400	3,400	96,200

D3.3 DOCUMENT ELEMENT BASIS

Bismuth, chromium, iron, silicon, phosphate, and sulfate in the flowsheet analysis are assumed to fully precipitate. The flowsheet analysis for the Bi, Cr, Fe, and Si agrees with the sample-based estimate; however, for the PO_4, and SO_4, the HDW model reconciles better with the sample-based estimate.

Fluoride, sodium, nitrate, and nitrite inventories can not be reconciled because these components are relatively soluble and would have exited the tank by the cascade system. The best source of information with respect to these compounds is the sample-based estimate.

Overall agreement of the sample-based inventories for the 241-B-110 cascade with the flowsheet projected inventory for the cascade is poor.

With respect to the sample-based inventory and the HDW-model inventory, several significant differences are apparent, for example, Al, Bi, Ca, Cl, Cr, Fe, Hg, K, Mn, Na, NH_4, Ni, NO_2, NO_3, Pb, PO_4, Si, S, U, and Zr vary by a factor of two or more.

Once the best basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments the number of significant figures is not increased. This charge balance approach was consistent with that used by Agnew et al. (1996a).

D4.0 ESTABLISH THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

The results from this evaluation are based on sampling data for tank 241-B-111 for the following reasons.

- Analytical results from two widely spaced core samples were used to estimate the component inventories. There is no reason to dispute the analytical results.
- Statistically, there was no horizontal stratification of the tank.
- Analytical results for the core samples are consistent with receipt of 2C waste.

These results are subject to future review because of the lack of reconciliation with the flowsheet projected inventory. Tables D4-1 and D4-2 show the best-basis inventory estimates for tank 241-B-111. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium, or (total beta and total alpha) while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Best-basis tables for chemicals and only four radionuclides (^{90}Sr, ^{137}Cs, Pu and U) were being generated in 1996, using values derived from an earlier version (Rev. 3) of the Hanford Defined Waste model. When values for all 46 radionuclides became available in Rev 4 of the HDW model, they were merged with draft best-basis chemical inventory documents. Defined scope of work in FY 1997 did not permit Rev. 3 chemical values to be updated to Rev. 4 chemical values.

Table D4-1. Sample-Based Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-111 (September 30, 1996).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment RSD %
Al	958	S	7
Bi	21,500	S	1
Ca	734	S	23
Cl	1,090	S	2
TIC as CO_3	23,600	S	11
Cr	1,180	S	5
F	1,660	S	2
Fe	18,800	S	5
Hg	9.93	S	50
K	718	S	18
La	12	S	27
Mn	83.9	S	6
Na	102,000	S	2
Ni	22.1	S	7
NO_2	47,800	S	9
NO_3	87,200	S	8
OH[2]	0	C	Accounted for by CO_3
Pb	1,670	S	7
P as PO_4	51,800	S	8
Si	11,100	S	8
S as SO_4	12,400	S	1
Sr	232	S	2

Table D4-1. Sample-Based Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-111 (September 30, 1996).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment RSD %
TOC	932	S	12
U_{TOTAL}	210	S	4
Zr	15.3	S	29

Note:

[1]S = Sample-based, M = Hanford Defined Waste model-based, E = Engineering assessment-based
[2]C = Calculated by charge balance; includes oxides as hydroxides, not including Co_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-111 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,or E)[1]	Comment RSD%
^{3}H	13.2	M	
^{14}C	1.7	S	36
^{59}Ni	11.6	M	
^{60}Co	< 4.12	S	
^{63}Ni	1170	M	
^{79}Se	11	M	
^{90}Sr	264000	S	22
^{90}Y	264000	S	Based on ^{90}Sr
^{93m}Nb	37.9	M	
^{93}Zr	50.5	M	
^{99}Tc	121	S	10
^{106}Ru	0.0376	M	
^{113m}Cd	216	M	
^{125}Sb	15.2	M	
^{126}Sn	17.1	M	
^{129}I	0.0341	M	
^{134}Cs	0.774	M	
^{137m}Ba	159000	S	Based on ^{137}Cs
^{137}Cs	168000	S	9
^{151}Sm	41000	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-111 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,or E)[1]	Comment RSD%
^{152}Eu	12.5	M	
^{154}Eu	181	S	26
^{155}Eu	932	M	
^{226}Ra	7.29 E-04	M	
^{227}Ac	0.00393	M	
^{228}Ra	0.00252	M	
^{229}Th	5.91 E-05	M	
^{231}Pa	0.00885	M	
^{232}Th	3.11 E-04	M	
^{232}U	0.0054	M	
^{233}U	0.0207	M	
^{234}U	0.14	M	
^{235}U	0.00613	M	
^{236}U	0.00164	M	
^{237}Np	0.0761	S	22
^{238}Pu	9.79	M	
^{238}U	0.143	M	
$^{239/240}Pu$	104	S	5
^{241}Am	90.1	S	25
^{241}Pu	683	M	
^{242}Cm	0.345	M	
^{242}Pu	0.00392	M	
^{243}Am	0.0116	M	
$^{243/244}Cm$	0.816	M	57

[1]S=Sample-based
M=Hanford Defined Waste model-based
E=Engineering assessment-based

D5.0 APPENDIX D REFERENCES

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